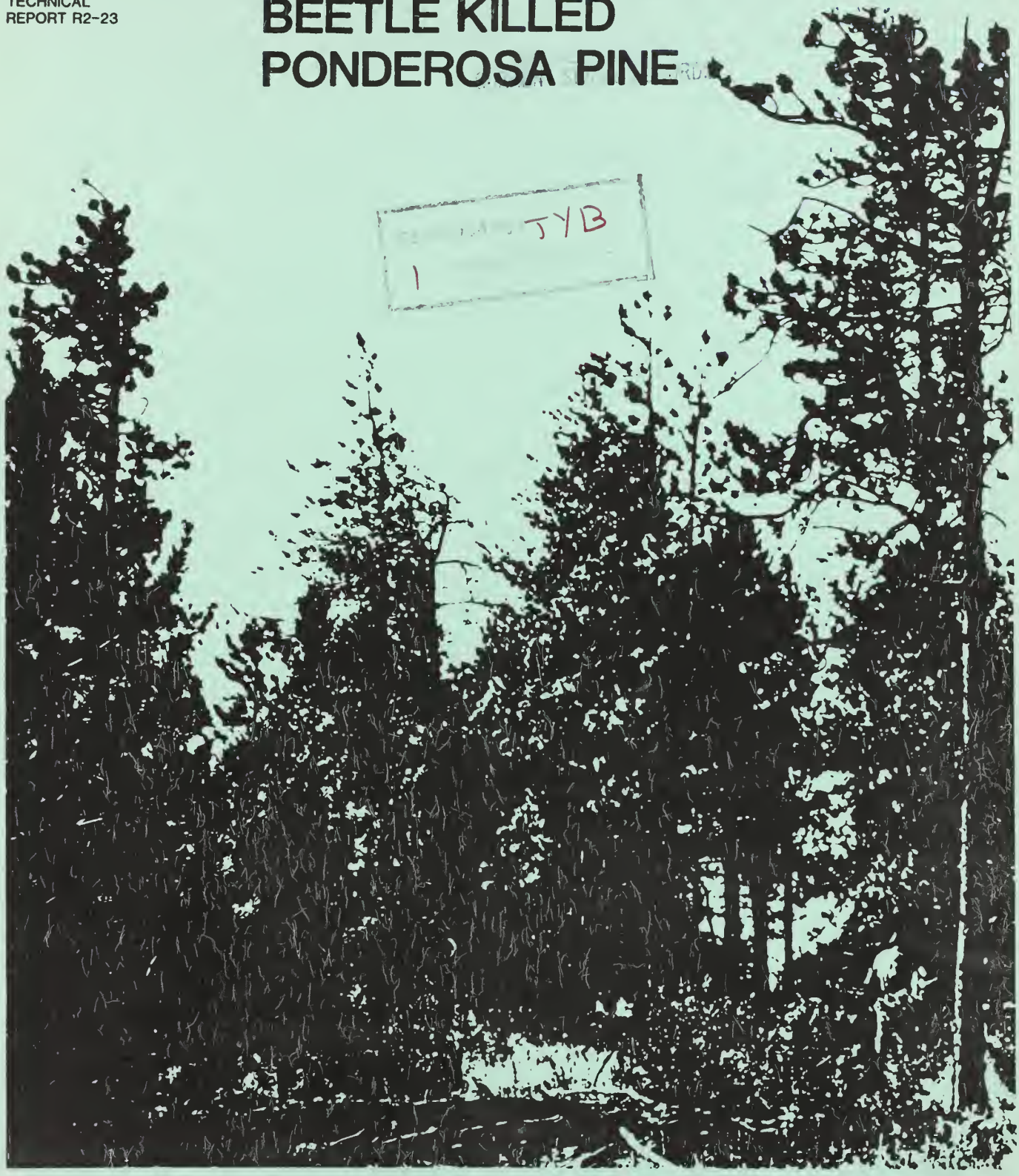
United States
Department of
Agriculture

Forest
Pest
Management

TECHNICAL
REPORT R2-23

GROUND TRUTHING MOUNTAIN PINE BEETLE KILLED PONDEROSA PINE



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RELIABILITY OF GROUND TRUTHING MOUNTAIN-PINE-BEETLE-KILLED PONDEROSA PINE AFTER BEETLE EMERGENCE

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TECHNICAL REPORT R2-23

AUGUST 1981

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Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

INTRODUCTION

In the western United States, bark beetles cause more tree mortality than any other insect group or any disease. In Colorado, mountain pine beetle (MPB) infestations have been highly visible and of general public concern since 1972 (Lister, 1980).

In 1979, a pilot test was undertaken to assess the usefulness of panoramic aerial photography to estimate the annual mortality of ponderosa pine by the MPB in Colorado (Dillman et al., 1980). This survey included the Colorado Front Range from Denver southward to the New Mexico state line. The success and accuracy achieved with the 1979 pilot test led to an operational survey in 1980 of the entire Colorado Front Range from Wyoming to New Mexico, using the same techniques as the 1979 survey (Dillman et al., 1981). The 1979 pilot survey was designed primarily to test the accuracy of the photo interpretation in assessing ponderosa pine mortality. The ground truth of the photography was assumed to be completely accurate.

During the planning stages for the 1980 project, some questions were raised as to the accuracy of the ground truth; that is, were the trees that were classified as new faders (trees attacked by MPB the previous year) really new faders? The reason for questioning fader classification follows: When the ground truth is conducted (September through October), the insect has already abandoned the tree. Fader classification is accomplished by backdating, using combinations of the following characteristics: Needle retention, needle color, amount and freshness of frass in bark cracks and at base of tree, freshness of pitch tubes on tree, dryness of wood beneath bark, looseness of bark, and appearance or absence of fungi and mold along phloem layer. All of these can vary from site to site and year to year, depending on various environmental factors.

Misidentification of the year of tree-fading had the potential to be a significant error factor in a survey where ground truthing for faders occurred after beetle flight. To answer this concern, an assumption was made that if treefading plots were visited at the same time as ground-truth plots for the loss assessment evaluation were visited and techniques of identification were the same, then a comparison of results from the tree fading should be appropriate.

Naturally, the best method for identifying current faders is to check trees before insect flight for the presence of live insects. To date, a survey has not been designed that offers this option.

OBJECTIVE

The objective of the tree fading study was to determine if the crews in the field conducting the ground truth were accurately identifying the year of fading for ponderosa pine.

METHODS

A total of 27 tree-fading plots were established throughout the Front Range[1]. The Front Range of Colorado is approximately 12 million acres and includes portions of Pike, San Isabel, Arapaho, Roosevelt, and Rio Grande National Forests. Excluding the North Park area and San Luis Valley, this area includes the Rocky Mountains east of the Continental Divide from the Wyoming state line southward to the New Mexico state line on the south. Each plot contained a group of trees killed by mountain pine beetles (1980 faders). Plots averaged 2 acres in size and had current-year fader counts ranging from 8 to 108 (Table 1). These plots were established during July and August before beetle emergence. All dead trees were checked for MPB, then blazed and numbered. If MPB were present, the tree was recorded as a new fader. All other numbered trees were recorded as old faders.

These plots were again visited during the ground-truth phase of the operational loss assessment evaluation titled "Panoramic Aerial Photography for Estimating Annual Mortality of Ponderosa Pine Caused by Mountain Pine Beetle" (Dillman et al., 1981). This time crews recorded trees as either old or new faders based on accepted techniques. Because of wood cutting activities on 5 plots, only 22 of the 27 plots remained in October.

The results of this study are based upon the following statistics:

Let D denote the difference between the actual number of new faders and the number of new faders counted at the ground truth visit for plot i; then the mean difference ($\overline{D}$) and its standard error (S_D) can be estimated by:

1/ Locations for the 27 fader plots are on file at the Region 2 Forest Pest Management office, 11177 W. 8th Avenue, Lakewood, Colorado 80225.

$$\bar{D} = \sum_{i=1}^{m} D_i/m$$

$$s_{\bar{D}} = s_D \quad m$$

where

$$s_D = \frac{\sum_{i=1}^{m} (D_i - \bar{D})}{m - 1}$$

The statistical significance of the mean difference ($_D$) can be tested using t-statistic with (m-1) degrees of freedom.

$$t = \bar{D}/s_{\bar{D}}$$

The null hypothesis that $_D = 0$ is accepted if $t < t_c$, where t_c is the critical value of t at 5 percent probability level and (m-1) degrees of freedom. The null hypothesis is rejected if $t > t_c$.

RESULTS

The results of the test of significance (Table 1) indicate that there was no evidence to reject the null hypothesis that $_D = 0$. This means that the field crews identified new faders after beetle emergence with no significant bias.

CONCLUSIONS

If the results from the tree-fading study are applicable to the ground truth data set for the loss assessment evaluation, then, collecting field data on ponderosa pine tree fading after beetle emergence is not a critical bias factor as previously believed. Based on this assumption, loss assessment surveys need not develop correction factors relative to ground-truthing the faders after beetle emergence. However, efforts must be made to eliminate errors that existed; better training of field crews will help.

Table 1. Data for the Test of Reliability of Ground-Truth Counts*

Plot #	Number of New Faders		Difference D_i
	Actual	Counted at Ground Truth	
1	10	18	-8
2	21	23	-2
3	15	15	0
4	14	14	0
5	25	27	-2
6	24	26	-2
7	38	37	1
8	20	35	-15
9	14	15	-1
10	29	33	-4
11	51	49	2
12	22	26	-4
13	108	128	-20
14	37	45	-8
15	8	7	1
16	27	8	8
17	63	62	1
18	16	17	-1
19	24	24	0
20	55	54	1
21	24	29	-5
22	96	105	-9

* $t < t_c$: null hypothesis accepted.

$\overline{D} = -2.59$
$s_D = 7.2$
$s_{\overline{D}} = 1.54$
$t = -1.68$
$t_c\,(21,\ 0.05) = 2.08$